ELECTRON-ELECTRON SCATTERING AT 15.7 MEV.

BY

MERRILL BLOOD SCOTT

B.S., University of Illinois, 1946
B.S., University of Illinois, 1948
M.S., University of Illinois, 1949

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSICS
IN THE GRADUATE COLLEGE OF THE
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R. UNIV. BIBLIOTHEEK LEIDEN

ELECTRON-ELECTRON SCATTERING AT 15.7 MEV.

The theoretical evaluation of the elastic scattering cross section for electron-electron collisions has been carried out by Møller[1] using the Dirac wave equations.

Experimental verification of this theory has been attemped by several investigators[2,3,4] with somewhat ambiguous results.

The present work was carried out with monokinetic electrons from the 22 MeV. betatron. An external beam of 15.7 MeV. electrons was focussed by a magnetic lens on a scattering foil of 1 or 2 mil nylon at the center of a 20 inch diameter scattering chamber. The incident current after passing through the scatterer was collected by a Faraday cage and measured by a vibrating reed electrometer. The scattered current was defined by gold lined slits of known solid angle at a known angle to the incident beam. A momentum interval of the scattered electrons was then selected by a magnetic analyzer of the Nier type and the number of electrons per unit incident charge in this momentum interval was detected by a Geiger counter.

Energy analysis of the scattered electrons makes possible the separation of the nuclear scattering events from the electron scattering events since the electrons scattered from nuclei have very nearly the incident energy and those scattered from electrons have a lower energy characteristic of the scattering angle.

The energy of the scattered electrons was measured as a function of angle and was found to be in agreement with the laws of relativistic mechanics within an experimental accuracy of .4%.

The shape of the curve of energy of scattered electrons as a function of scattering angle was used to check the absolute energy of the incident electrons. The energy was found to be $15.62 \pm .1$ MeV. which is in good agreement with the energy

of $15.7 \pm .15$ MeV. determined by comparison with the Cu^{63} (γ,n) threshold of $10.9 \pm .1$ MeV.

The relative scattering cross section for electron-electron collisions agree with the Møller formula and for the electron-nuclear collisions with the relativistic Mott theory (Born approximation) corrected for the Schwinger effect[5] (3 to 8%). The experimental consistency of the cross sections was about 4%.

The absolute differential scattering cross sections for the electron-nuclear scattering were measured from 10 to 43 degrees. The average of all these absolute cross sections was 2% lower than theory which is probably due to systematic errors in the solid angle, and in the collection and counting efficiencies.

The absolute differential scattering cross sections for electron-electron scattering were measured at nine angles in the interval 10 to 43 degrees in the laboratory system (corresponding to the angular interval from 70 to 150 degrees in the center of mass system). The average of these absolute cross sections was 7% lower than theory. The bulk of the 5% additional departure from theory is probably due to a systematic error in the measurement of the momentum interval defined by the counter.

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VITA

Merrill Blood Scott was born in Grayville, Illinois on January 25, 1927. He entered the University of Illinois in February 1944 in the College of Commerce, and received his B.S. degree in Accountancy, with honors, in June 1946.

He transferred to Liberal Arts and received a B.S. degree in Physics in February 1948. In September 1947, he entered Graduate School at the University of Illinois, majoring in Physics, receiving his M.S. in Physics in June 1949.

He was appointed Scholar of the University in his first Graduate year, and Fellow in his second and third years. In the summers of 1949 and 1950 he held appointments as Research Assistant in the Department of Physics.

He has published a preliminary abstract of the present work entitled, "Electron-Electron Scattering at 15.7 MeV." in the Bulletin of the American Physical Society, *25*, 5, 21 (1950).

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